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AUTHOR Dawson, George
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ABSTRACT

A professor of science education at Florida State University shares his experiences with the growth of the field of environmental education and the problems inherent in trying to teach formal environmental education outdoors. Although field experience is best, it must be limited in most situations since logistics get in the way. Technology can help. Computers have the advantage of allowing for nonlinear programs that allow students to learn in all directions. This idea became the basis of the design of all curriculum materials prepared by this professor since then and reflects how people work outside of a formal classroom setting. The current focus is a multimedia program known as ScienceVision. One of the titles in the program--EcoVentures--is detailed in this paper. The problem that EcoVentures addresses is that there is increasing pressure on environmental resources in Florida, owing greatly to the 800 plus new citizens gained each day. EcoVentures creates a fictitious state park. The lower secondary students for which this program is intended pretend to be interns working with the Florida Department of Environmental Protection to develop a management plan for the new R.U. Green Park. This paper demonstrates all the major components of the program and presents a typical path followed by a student using the program. (PVD)

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The Integration of Multimedia and Field Experience

Paper Presented to the Best of Both Worlds Conference
March 23, 1998
Pretoria, South Africa

By
George Dawson
Professor, Science Education and
Director, Interactive Media Science Projects
Florida State University

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Introduction

It is a real pleasure to be here at this conference. The setting and the topic will make this event one that we all will refer to for the rest of our lives. There are some conferences that are watersheds in our lives. That is, they have an impact on the way we think and the way we behave for the remainder of our lives. This conference promises to be such a life changing event.

The organizers have done an amazing job just to get you here and to have such an impressive array of people participating. You must all thank Josef de Beer, Callie Loubser and the many others who have given of their time to make this program a success. You will have plenty of opportunities to do this as we will be seeing a lot of them over the next few days.

The purpose of this presentation is to share with you some experiences, past, present and future that may give you something to think about, and hopefully use, as you go back to your jobs at the end of this week.

I have had the good fortune to work at a number of locations around the world for a variety of reasons. When I am outside my office, whether it be on the way home, walking a trail in Costa Rica, or on a beach in Tahiti, I take in the view through the eyes of one interested in the environment. That view is also seen through the glasses of an educator. However, in too many places I see that we are not taking care of our natural heritage. What I see is a real need to educate people about degradation of our environment and to encourage them to take action. There are those, and you are among them, who use the tools and the position that they have available to them, to make things happen. One such person is Carl Hiaasen, an investigative reporter writing for the Miami Herald about the environment. He speaks of the 60 percent of the Florida wet lands that have been drained for development. "It's a disaster we don't think about as a crime, but it is. There are counties and politicians who are always willing to rollover for a developer. Since the turn of the century Florida acreage has been the Golden Currency." Local policy makers show no inclination to save much of the coastline or green space. What he speaks of next is what gives me and, I expect, you, a reason to continue our work. He states "There are pockets of sanity and tranquility where somebody sane and with a reverence for nature has prevailed, but it usually is a refuge or park." I would like to share some of those pockets of sanity with you.

In 1991, my wife and I met a woman who was running an environmental center just off Arbat street in Moscow. She started this as an after school project in an attempt to get students to become more involved in solving environmental problems in their country. She was appalled at the environmental damage that was being done in the Soviet Union. She was, and is determined to make a difference in the attitudes of the government regarding the environment and spends many hours of her time outside of her regular teaching. She gets no support from any public sector but somehow keeps the center open with volunteers.

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As concern for the environment began to generate global interest other parts of the world began efforts to educate their citizens. I had the pleasure of assisting the Arab League in 1974 in developing a framework for environmental education for the Arab world. This effort, headquartered in Cairo, Egypt resulted in a program that was used in much of the Middle East. All of these programs relied on print and some field experiences as the media of delivery.

My tools and skills that I can apply to the struggle are in the area of curriculum development. I want to share with you some things that have happened in the past that I think have been major turning points in my professional life and that have affected my contributions.

One was a response to Sputnik. As a science educator I give thanks to the Soviets frequently because their placement of this satellite in orbit made the U.S. recognize how far behind we were in our teaching of science. The interest in changing the situation resulted in a period of time known as the Golden Age of Curriculum Development. The Biological Science Curriculum Study produced a upper secondary biology program know as the Green Version. This program was known in many countries as The Web Of Life. The Green Version was radically different from the existing biology texts. It stressed ecology rather than the simply learning the names of the parts of plants and animals. The major textbook at that time was a program called Modern Biology. It had about 95% of the sales for this level in the U.S. It focused on naming tissues and organs which required the memorization of some 4,000 new terms. The Green Version introduced the notion of inquiry. The BSCS Green was looked upon as the easier of the three versions as ecology was viewed by some as a soft science. When researchers started looking at the elusiveness of ecological concepts it was no longer looked upon as the program for the non-science bound. It is now considered the premiere biology textbook in the U.S.This change put the focus on learning using the processes of science rather than just being able to define a term. Let me illustrate the difference. Take time to rub your hands together real fast. Why are your hands getting hot? If you answered friction, I would give you a failing grade on a test. You would have received an A in Modern Physics which is a companion to Modern Biology. Why the F? I asked why your hands got hot and that word, friction with which you probably responded, may or may not tell me that you understand why your hands got hot. My experience is that most of us do not understand how rubbing our hands together releases heat. What the BSCS stressed was learning for understanding, not just memorizing terms.

The second important thing about the BSCS is that it took an ecological approach to the learning of biology. The environment was the central focus and was integrated into every topic of biology. I went from a field test teacher of pre-publication versions of the Green Version to working on a number of their development efforts. This experience changed my approach to how I taught everything.

Another project taught me to rely more on the creativity of my students. This program was called Environmental Science and was radically different from anything then or now on the market. And I add that it was controversial. It turns out that the Environmental Science project was as much for changing the classroom environment as much as it was about the great outdoors. Here is an example assignment from the program.

> The Action: Go outside and find as many different kinds of eggs as you can and bring them back.
> More:
> - Try to keep the eggs alive, hatch them, and then keep the young animals alive

- Can the animals be raised?
- Find some "eggs" of social change. How can they be kept alive? Do they all hatch and live?
- Predict what would happen if all the eggs hatched and reproduced.
- What does it mean to be an egg?
- Collect photos of many different eggs, then make a montage of them.

The entire program for one year consisted on 100 of these cards! ES students were expected to apply their unique interests and abilities to solving a problem or pursuing an issue. And their contributions were valued. This valuing of each individual is so important. We in the U.S. struggle with the challenge of educating a diverse student population and perhaps a program like this should be reexamined as a tool for reaching a wider range of students.

I once created a list of what I would wish for any school kid to do as part of their education. At the top was "Spend their formal education out of doors." If this is not possible then as much of it as possible would be supplemented by laboratory experiences. My least attractive choice would be to put them in a classroom listening to lectures and answering questions at the end of the chapter. An interesting aside here is that we once surveyed a rather large number of students around the U.S. and near the top of their list of concerns was that of the destruction of the environment. On the other hand, one of their favorite leisure activities was to go to malls and hang out! This wish list was made soon after I finished a three year masters program in biology that was heavy on field experiences. There is considerable evidence that hands-on, minds-on, and as my good friend Josef De Beer stated so well, hearts on, teaching is highly desirable. Direct experience is clearly the way to learn (Kubota and Olstad) and I expect any environmental education program to be rich with these experiences. The difficulties students have in generalizing science instuction to the natural world is well documented. Sessa, Gunstone, Linn, Resnick, Songer, Tiberghien .

Field experience is best but must be limited in most situations. Logistics get in the way. Getting transportation, worrying over the risks associated with having kids away from school and the problem of deciding who can go and who stays keep field trips from occurring. A secondary teacher may see 175 - 200 students a day. A teacher may be able to take 20 or 30 on a field experience. What happens to the others while this privileged group is gone for the day? We have a program at Florida State called Saturday at the Sea. It runs each Saturday for about 20 Saturdays a year. The program can take 20 students at a time, so at most 400 of the 25,000 students in our city can experience that trip each year. There are many good activities that can be done on a school ground but there is nothing like experiencing the natural environment. You can, of course, learn a lot about what not to do to an environment at or near most schools. There are also some wonderful programs for getting students into the out of doors. One that many of you may have heard of is Project Wild. The key to the success of this program is a cadre of teachers who volunteer to teach classes on weekends and holidays. They run initial and refresher courses for teachers. Their inservice model is one to consider if you are trying to implement a program into schools.

As I studied more about what an environmental education program should cover (I saw it initially only as ecology) I read a lot and talked to many people about the topic. A colleague of mine, Professor Lehman Barnes, and I did a survey on the campus of Florida State University in 1971 to try to determine who included environmental content in their programs. The purpose of this was to determine what interest there was in creating an environmental studies program. What we found is that nearly every discipline claimed the topic as their own. Since everyone claimed environmental education as theirs (I think many of them saw funding opportunities) I had real problems

conceptualizing what the content on an environmental education program would look like. Fortunately, there were others who were grappling with the problem as well.

A seminal event in Environmental Education was the Tbilisi Conference held in Tbilisi, Georgia in 1978 then part of the Soviet Union. It is considered to be a turning point in the environmental education movement because it gave some direction and focus to the discipline . Two statements in the Role, Objectives and Characteristics of Environmental Education, were and are of interest to me. These are:

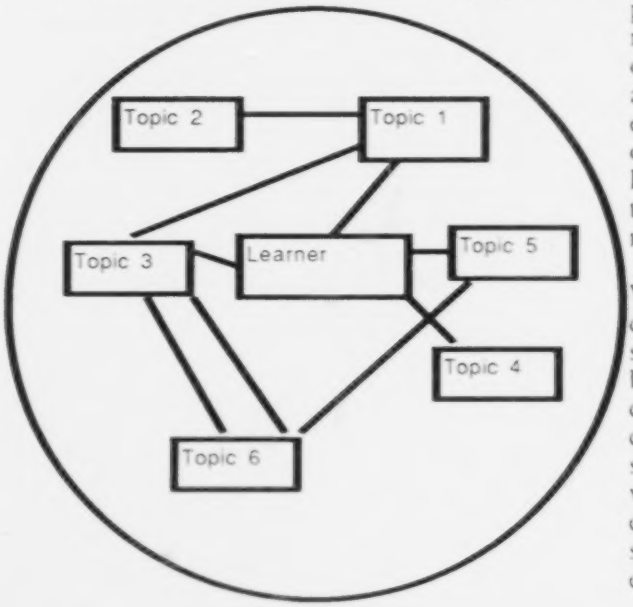
- Environmental Education should provide the necessary knowledge for interpretation of the complex phenomena that shape the environment, encourage those ethical, economic and aesthetic values which, constituting the basis of self discipline, will further the development of conduct compatible with the preservation and improvement of the environment; it should also provide a wide range of practical skills required in the devising and application of effective solutions to environmental problems.

- To carry out these tasks, environmental education should bring about a closer link between educational processes and real life, building its activities around the environmental problems that are faced by particular communities and focusing analysis on these by means of an interdisciplinary, comprehensive approach with will permit a proper understanding of environmental problems (Connect).

As I began to think about the limitations of a classroom and the problems of getting kids away from schools, I turned to technology.

Role of Computers

Computer programs began to show up in schools in the U.S., Western Europe and in Japan in the late 70's. I bought my first computer, an Apple II in 1979 and saw my first program that simulated research shortly after that. The program was called Odell Lake. This was an important piece of software because students were required to use the science processes of observing, inferring and predicting. They also had to keep good records of who was eating whom and had to use their notes in order figure out the food web of Odell Lake. Another important feature was that the simulation was based upon actual research.



What I also saw during these early days of computer based programs was a lot of poor science programs that I would consider to be electronic page turners. Even with the crude graphics and other limitations of the computer, it was clear that this media had something to offer. I began to think about what a multimedia program about the environment would look like. I knew it should reflect, as nearly as possible, real events and issues and should be

pedagogically sound. At that time I gave consideration to the advantages and disadvantages of various media. I have already spoken of the richness of field experiences although Kubota and Olstad show clearly that if the intitial visit is short, very little formal learning occurs. Print material is cheaper to produce and distribute and has portability. Visual media is more expensive to develop and use. Movies, video and audio tape, CDs all require equipment which limits it's use to those educational entities that can afford the media. This is a big disadvantage to much of the world. But even in the poorest of countries media such as the internet is used in some educational settings The numbers of schools connected to the internet in the U.S. is about 75% but only 27% of classrooms have connections (CNN report, 26 Feb., 1998). In Leon County, Florida (Tallahassee) all classrooms are linked to the internet. .

What caught my eye in the late 70's was that the computer would allow me create programs that were non - linear. All the materials that I had written up to that time were linear. You began on page one and went through the book page by page. "The world's current notion of literacy is based on the square book..." (Carlson). I saw the opportunity to create products that let the user not only go back and forth as you could in a book, but in any direction. I started working on materials that put the learner inside of a "Learning Sphere." Inside of a sphere you can go in any direction but you are bound by the diameter of the sphere. If you think of the sphere as the content you want to learn you have defined the boundaries for a course or a topic. Inside the sphere you can go in any direction. This idea became the basis of the design of all curriculum materials that I have prepared since then. Another thing to consider is that as you increase the diameter of the circle and reach out to bring in a wider spectrum of content the volume of the sphere increases as the cube of the radius! Non-linear programs have a natural tendency to attract additional content.

This also seemed to me to reflect how we work outside of a formal classroom setting. In our work, whether you are an ecologist in the field, a teacher, or a person in nearly any job except on an assembly line, you work in spherical realms. Today in this conference you are going to move more or less in linear paths as we are being moved from place to place - from here to lunch to Dikhololo and to the planned events there. But in your normal work you may write a while, decide to talk to a colleague or other experts about an idea, return to your writing, step outside to think, spend an hour in a seminar being given some information, walk to the library for a reference, step into the lab for a while to check on an experiment, and then go off to your study site to check on the movement of the troop of baboons that have settled near a village. What I wanted to do was to put students in a situation that more closely resembled the latter non-linear learning model. So a key feature of materials that I have developed is the notion of learner control. Early computer programs were written much like books but they had a disturbing, at least to me, characteristic. Most of them controlled the content and made the delivery of instruction more inflexible than did a textbook. A student, in order to move to new text had to answer questions. These had to be written exactly as the programmer expected, including the proper case and spelling. Frequently the student was faced with a screen that gave no feedback and did not let the person move. The Apple computer came along about that time and used a more graphical interface and had the power (48K of ram) to allow for a more flexible and user friendly interface, but the programs stressed rote learning and highly controlled the way a person went about learning. What I set out to do was to turn control over to the student rather than leaving it with a computer. Most of the programs at that time were built around an objectivist perspective, while I approached learning as a constructivist. An objectivist considers knowledge as separate from knowing, and learners acquire knowledge through the use of the senses (Lakoff, 1987). A constructivist (von Glasersfeld, 1989) assumes that knowledge cannot exist outside the body of a learner. This is not to say that physical events are not occuring, but the sense is made by humans and the sense making is negotiated by the participants (Tobin and Dawson). Any curriculum materials that I develop will be built on this model. This means that information will not be given to a student to accept as truth, but that they

will have to discuss and make part of their knowledge scaffolds new information. If knowledge is can be thought of as a framework or scaffold, then the structure must change to accommodate new information. Making of meaning rather than acceptance of the meaning given by others is a central element of our development efforts.

In 1987 I was fortunate to have received funds from our National Science Foundation to work on a multimedia program known as ScienceVision. One of the titles in the program was EcoVision which highlighted environmental problems and solutions world wide but focusing on the U.S. We learned a lot about the integration of multimedia and field experiences from this work. Some key people at the Florida Department of Environmental Protection had seen ScienceVision and then contracted with my project to develop EcoVentures.

EcoVentures

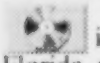
We have just finished the CD version of EcoVentures and I will share it with you now. It illustrates how we have brought our ideas together. The program that I will share with you is EcoVentures: Learning in Florida's Environment. Our team is currently working on a national version that should be ready for distribution by the end of this year.

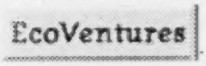
Money for the development of EcoVentures came from the Florida Department of Environmental Protection (DEP). The problem we wanted to address is that we have increasing pressure on our environmental resources due greatly to the 800 or so new citizens we gain each day. People are moving to our state for a number of reasons, many for our aquatic resources, yet we are destroying the very things that make Florida a desirable place to live.

We decided to create a fictitious state park. The lower secondary students for which this is intended are interns working with the DEP to develop a management plan for the new R.U. Green Park. Here is the opening screen for EcoVentures. It is an outline of the new park. Picture in your minds a similar park in your area. How would it look?

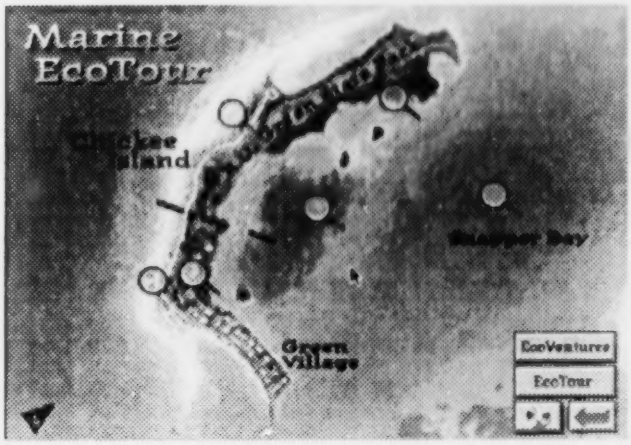
By selecting from the menu bar at the top of the screen or any of the three icons at the bottom right students can choose to explore elements of the program. In this article I will demonstrate all the

major components while showing a typical path by a student using EcoVentures.

There are two major sections of the park, the Marine Site, including the bay and island, and the River Site. Selecting either of these icons takes you to the respective section of the program. The  icon brings you to a 5 minute movie describing some of the environmental issues facing Florida, and introduces the five on-screen interns, called the EcoVenture Team. In our example we will explore some of the Marine site resources. Here is the screen the student sees when the Marine Site is selected.

Note that there are some new icons on the screen. These are and  .

When the Ecotour icon is chosen a magnifying glass appears over the site screen marking the habitats where a student can go to observe and learn about organisms. There are a total of 15 EcoTours on the CD.



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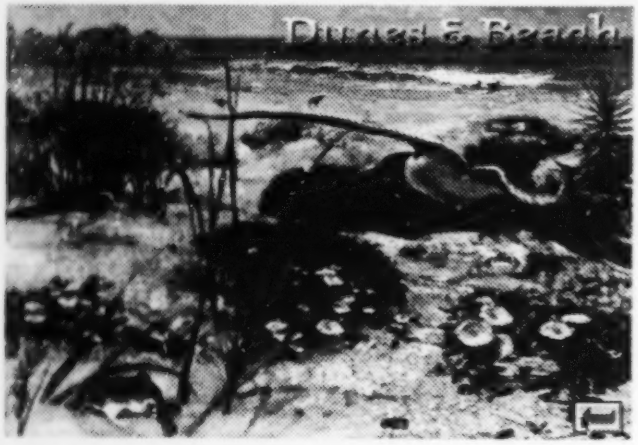
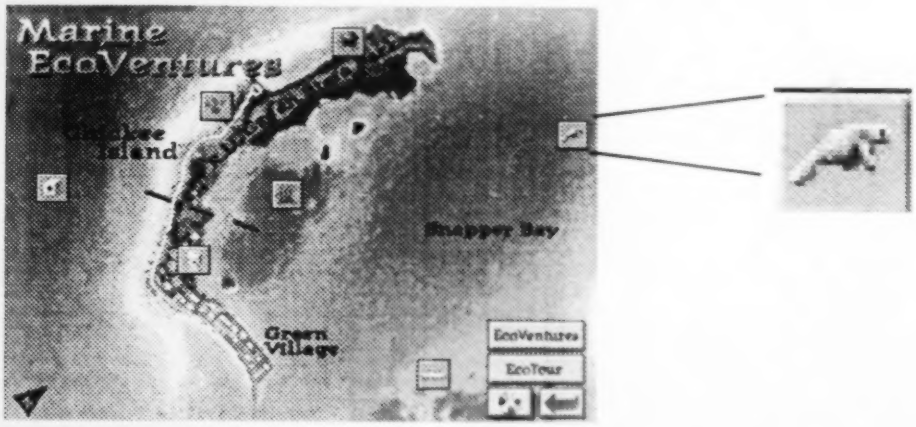
Clicking on one of these brings up a screen with selectable objects.



Pick any organism show on the screen and a slide or movie with text is displayed. There are about 700 pictures of Florida's wildlife on the CD available through these EcoTours and the illustrated Field Guides. These graphic resources give our students a good overview of what lives in the different habitats in our state.

Selecting the **EcoVentures** icon leads us to the heart of our program. EcoVentures are the activities designed to give students an understanding of research being done that will lead to better understanding of our environment and to address some of the social issues related to protecting our very fragile home.



For illustrative purposes the activity Manatee Tracking will be selected and then described. Students do this activity to help them make recomendations about controlling boat traffic to protect the manatees

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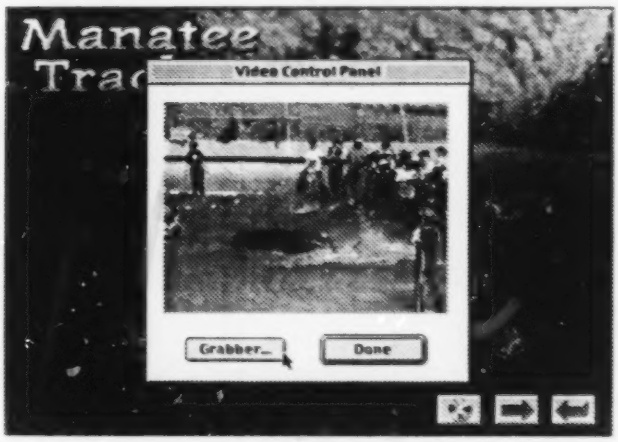
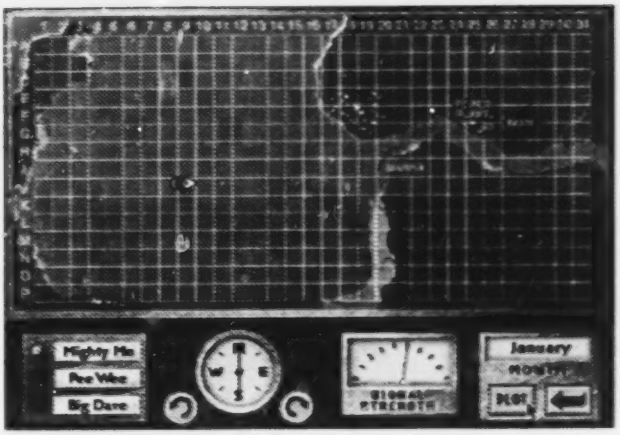
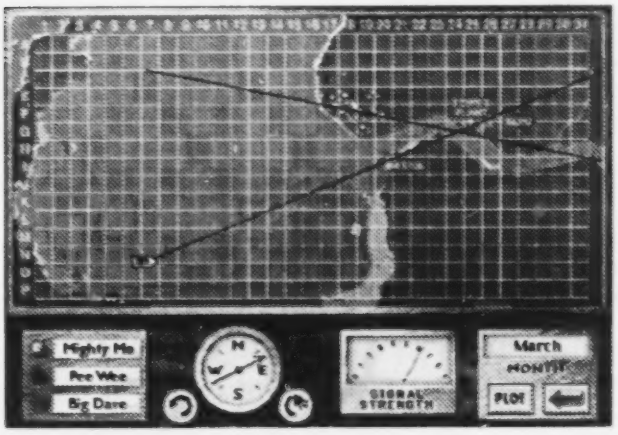
Here the student has three choices. They can look at a movie clip which shows how a manatee is captured and collared, move to the next screen, or move back to the prior screen (they can move to other screens by going to the menu bar at the top of the screen).



The forward arrow takes them to an instrument panel in their small research vessel. Their task is to track three manatees over the course of the year. This information will enable them to make decisions about how to protect them. There are an estimated 2600 of the endangered West Indian Manatees in the state. About 10% of them die each year from a variety of causes. Being cut or crushed by boats kills about 55 of them per year.



There are several decisions that have to be made at this point. The student must pick a month and a manatee to track. In order to locate the manatee they have to pick up a radio signal from the manatee and use signal strength to determine the direction from the boat. The boat is placed in two locations and a reading taken. Where the two lines intersect is where the manatee is during the month.



In the winter months the manatees stay around the warm outflow of a power plant and in the summer they are in the sea grass meadows (which the students can visit on an Ecotour). The recommendation at the end of this activity should include some restriction on boat movement in the areas where the manatee is concentrated. All data is recorded in the Field Note Book.

As most schools have only a few computers (perhaps just one) the question comes up "What are the other students in the class doing?" The CD includes a text about Florida's environment and a laboratory manual. There are 22 activities in the manual that extend the on-screen lessons or address concepts not on the CD. One of the activities is named "Where is my textbook?" Students learn to triangulate in order to locate the textbook and other objects before doing Manatee Tracking. Keep in mind, nothing beats a good field trip to a local environmental site to learn this skill.

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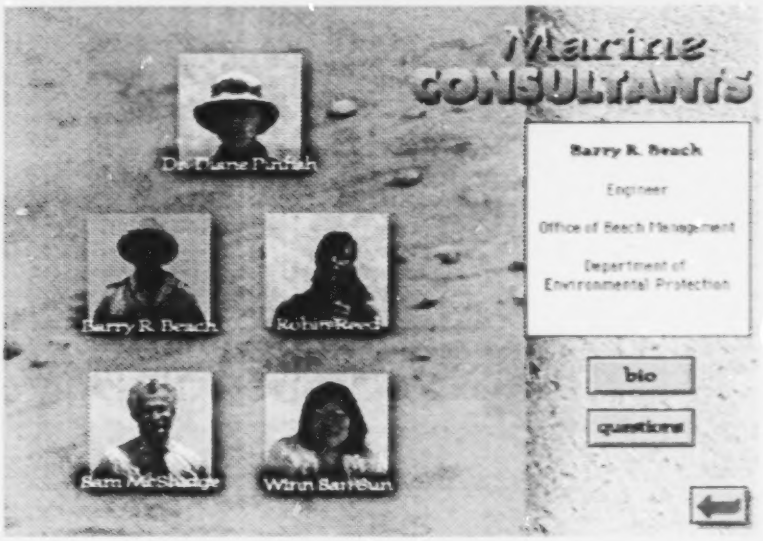
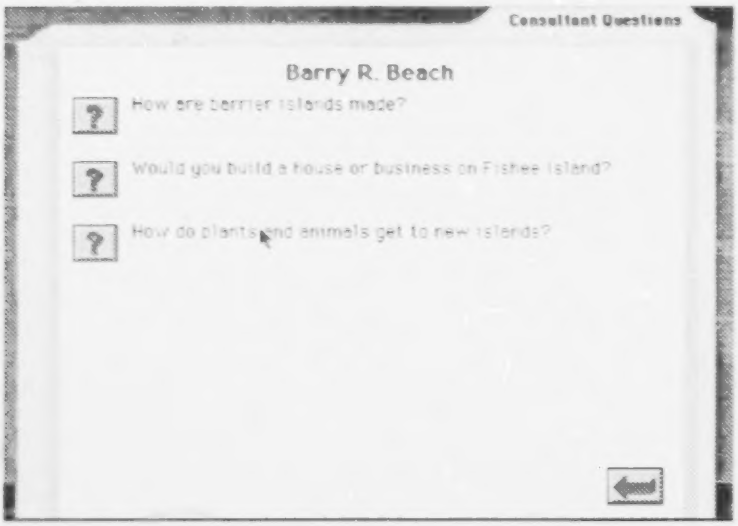
There are other resources available to the student. At the top of the screen a References bar can be pulled down. One of the references is a group of consultants.



We show men and women from all backgrounds in the program. When one of the consultants is picked, a biosketch of the person can be read or context sensitive questions can be asked. The bio is designed to show that researchers are real people sharing the same range of interests as non-scientists. They do have a life outside of their research. We also give career information here so the kids understand what schooling they will need if they want to do this work. If the Questions box is picked then the questions related to the activity or site are presented. When one is selected a video clip related to the question is played.


Consultant Questions
Barry R. Beach
How are barrier islands made?
Would you build a house or business on Fishee Island?
How do plants and animals get to new islands?

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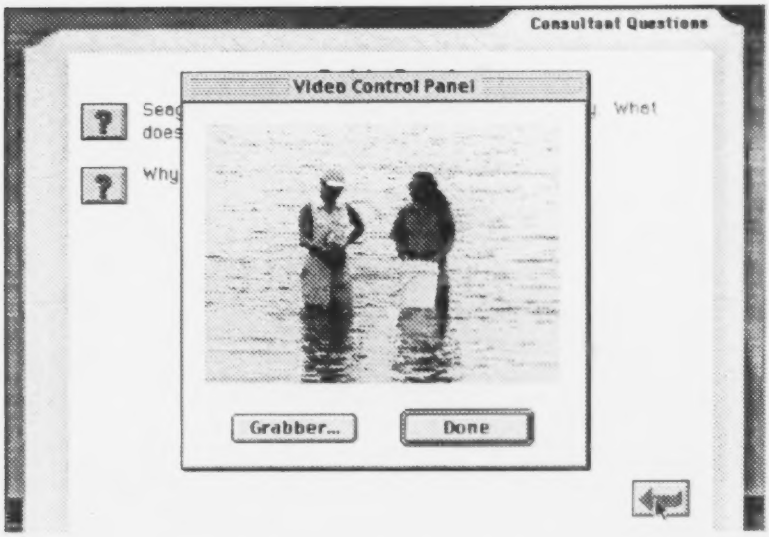
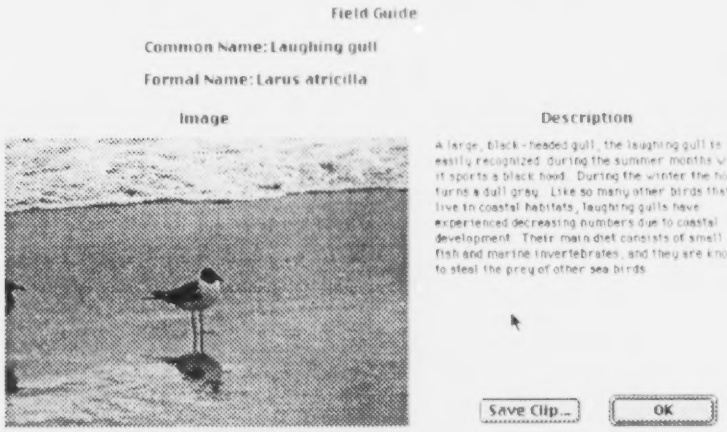


Other resources are Field Guides and a Video Encyclopedia.


Field Guide
Common Name: Laughing gull
Formal Name: Larus atricilla
Image
Description
A large, black-headed gull, the laughing gull is easily recognized during the summer months when it sports a black hood. During the winter the hood turns a dull gray. Like so many other birds that live in coastal habitats, laughing gulls have experienced decreasing numbers due to coastal development. Their main diet consists of small fish and marine invertebrates, and they are known to steal the prey of other sea birds.
Save Clip...
OK

The Field Guides are another way to get to the pictures from the EcoTours, but with even more choices. The Video Encyclopedia is for defining terms rather than showing more organisms.

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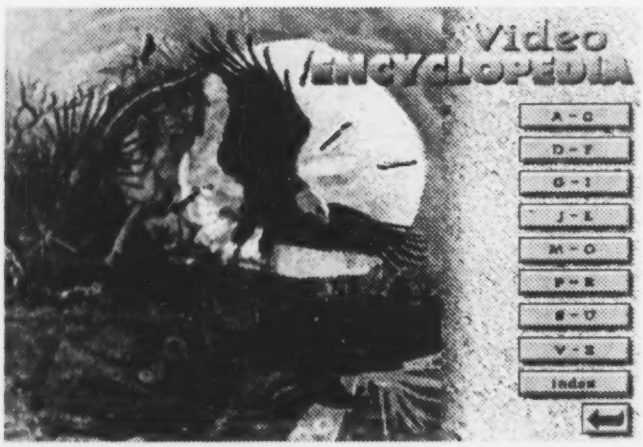

The Tools menu bar, located at the top of every Mac or Windows screen in the program varies from activity to activity. In some places a contour map of the area will be displayed, and at another, a map of endangered specials will be shown.

Context sensitive help is available from the menu bar. Help is also available in other ways. At times a student can click on a telephone icon and get the appropriate consultant on the phone.

There are other resources available on the CD but this overview has touched upon the dominate ones.

Assessment

How do we evaluate field trips whether simulated or real? If you are going to have students do problem solving activities using the creativity that they each have, and build upon their interest and then test using an instrument that only requires the regurgitation of facts, you will not have a very successful program. What we have done are turn to some alternatives to the standard evaluation practices. We have not dumped tests, as they are an assessment alternative, but even these tests have changed to become more problem based. A teacher may evaluate what they contributed to the development of the Management Plan for the park. Here are some of the the things we ask our students to do in order to show competence with the content and processes we were stressing.

Some of the alternatives we suggest for students are in the Educator's Guide and include the following: create artwork; make a booklet or brochure about the park; create a concept map; make a database based upon one or more of the EcoVentures; invent a game; make graphs; write a newspaper article about the new park; create a multimedia presentation; make a model of the park; develop a photo essay; conduct a survey; teach a lesson; conduct research on some environmental problem. What follows is the detail a student will get if they go to the respective assessment area, in this case Creating a Multimedia Presentation.

> Creating a Multimedia Presentation
> Make your own slide show or movie using the computer to "cut and paste" images from the CD. You can also write and insert caption cards into your movie or slide show.
> Saving Still Images for Your Presentation 1. Select still images for your presentation from the Field Guides or Video Encyclopedia by going to the image

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you want to save. When the image appears on the monitor, a corresponding dialog box appears on the computer screen. Click on Save Clip.
2. Enter a name for the image and click OK.
3. Repeat the first two steps for additional still images you want to include in your presentation. NOTE: You can save images in any order and rearrange them later in the Presentation Builder.
Saving Video Clips for Your Presentation 1. Select video clips for your presentation by going to the video clip you want to save. You can save entire clips or parts of a longer "movie."
2. As the video clip is running, click on Grabber, displayed on the computer screen.
3. You will see a horizontal scale with two small, square buttons on either end and a pointed box in the middle. Drag the pointed box to the left of the scale while watching the video. Release the mouse when the video reaches the point that you want to begin your clip. Drag the small square on the left end of the scale until it meets the pointed box. Now, drag the pointed box to the right until you reach the point where you want to end your clip. Drag the small square on the right end of the scale until it meets the pointed box.
4. Click on Preview to see your edited video clip.
5. Click on Save and name your video clip.
6. Repeat steps 1-5 to save additional video clips.

Building Your Presentation 1. When you are ready to assemble your still and moving images, select Presentation from the Edit menu. All your saved images appear at the bottom of the screen.
2. Arrange your images in the order you want them to appear in your presentation by dragging each image/clip to a segment of the "filmstrip." Leave a space before or after each image where you want to include a caption.
3. To write a caption for an image/clip, select New Caption from the Presentation menu. Fill in your caption and name it. The caption will appear at the bottom of the screen. Drag it to the filmstrip segment where you want it to appear. You can also edit captions by double-clicking on the caption box and editing the caption.

Program Evaluation

How successful has the program been? Here are some results that have encouraged us. A number of researchers have found EcoVentures to be successful in teaching the intended content and positive attitudes have been generated. King (1997) found that team work was fostered; EcoVentures encouraged students to explore environmental issues; the interactive aspects of EcoVentures actively engaged students in the learning activities, and students at all ability levels were successful. These results support our notion that heterogenous groups working together on assignments learn from each other and that social benefits accrue to the group and to the class. (De Beer and Dawson)

Future Activity

We are currently working on a CD for the U.S. Department of the Interior on the Role of Fire in Ecosystems. This is an important issue as we have created some serious problems around the world with our respective fire suppression policies. But this is a story for another day.

In Closing

Keep in mind that there are people in all cultures, in every corner of this globe, who truly love our natural world. They are fighting hard to preserve what they can in whatever way they have at their disposal. They should be treated as heros and our job as environmental educators is to bring them new recruits. Thank you and have a great conference.

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